DOCUMENT RESUME

ED 194 547 TM 800 676

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TITLE Grade Prediction: The Usefulness of Context-Specific Predictors.
PUB DATE [80]
NOTE 11p.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Admission Criteria; Class Rank; *College Admission; College Entrance Examinations; *Grade Prediction; Higher Education; *Mathematics; *Physics; *Predictive Measurement; Predictive Validity; Predictor Variables
IDENTIFIERS ACT Assessment; School and College Ability Tests

ABSTRACT

Six widely used college admissions variables and four course-specific measures (tests of entering mathematical skills and physics knowledge, and indexes of previous study of mathematics and physics) were correlated with final marks for 495 students in an introductory college physics course. The college admissions variables included scores on American College Test (ACT) mathematics, ACT natural science, ACT composite, School and College Ability Test (SCAT) quantitative, SCAT verbal, and high school percentile rank. Separate stepwise multiple regressions revealed that the complete set of predictor variables accounted for 43.5% of the variance in course mark, whereas the six admissions variables accounted for only 28.6%. Similarly, the specially constructed tests of mathematical skills and physics knowledge were substantially better predictors than the corresponding admissions variables. These results suggest that prediction of success in particular instructional settings can be substantially improved if skills and knowledge specific to each setting can be identified and measured. (Author/RL)

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Grade Prediction: The Usefulness of Context-Specific Predictors

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Acknowledgement:

Support provided by the Physics Department and Office of Instructional Resources, University of Illinois at Urbana-Champaign, is gratefully acknowledged.

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TM 800 676

Abstract

Six widely used college admissions variables and four course-specific measures (tests of entering mathematical skills and physics knowledge, indexes of previous study of mathematics and physics) were correlated with final marks for 495 students in an introductory college physics course. Separate stepwise multiple regressions revealed that the complete set of predictor variables accounted for 43.5% of the variance in course mark, whereas the six admissions variables accounted for only 28.6%. Similarly, the specially constructed tests of mathematical skills and physics knowledge were substantially better predictors than the corresponding admissions variables. These results suggest that prediction of success in particular instructional settings can be substantially improved if skills and knowledge specific to each setting can be identified and measured.

Grade Prediction: The Usefulness of Context-Specific Predictors

Selection of applicants for admission to college has been one of the most extensively explored topics in educational research, with over 1000 studies published in the last 30 years. These studies have typically attempted to predict college grades or grade point averages, using as predictors measures of high school performance (gradepoint average or percentile rank in class), measures of scholastic aptitude, and measures of achievement. Many investigators have also studied the usefulness of personality, attitude, and demographic variables.

A quite stable pattern of findings has emerged from this research (Fishman & Pasanella, 1960; Lavin, 1965; Whitla, 1969; Commission on Tests, 1970). The best single predictor has usually been the measure of high school performance, with correlations between high school percentile rank (HSPR) or high school grade point average (GPA) and university grades ranging between .30 and .70, with a median value of about .50. Scholastic aptitude and standardized achievement test scores (such as ACT scores, SAT scores, or SCAT scores) collected immediately before or after admission to college have generally yielded slightly lower correlations than the measures of high school performance. Combinations of high school and aptitude variables have yielded multiple correlations in the range .40 to .80, with a median value of about .60. In general , only modest improvements in predictability have resulted from including personality, attitude, and demographic variables. It is important to note that the wide variation in correlations among different studies is largely accounted for by variations

in the range of abilities included in the samples (Fishman & Pasanella, 1960). Correlations and multiple correlations for students enrolled in colleges with highly-selective admissions practices are generally substantially lower than those for students in less selective institutions, because of restriction of range on the predictor variables. This effect is well illustrated by a study which found that increases of selectiveness at one institution over a five year period halved the proportion of variance in GPA which could be accounted for by admissions variables (Bowers & Loeb, 1972).

In an attempt to improve the prediction of academic performance, a substantial number of investigators have studied the usefulness of differential prediction (the use of different prediction equations for specific courses, curricula, or departments). The results of this research have generally been disappointing, with only modest improvements in predictability in most cases. However, some studies have reported substantial improvements resulting from the differential prediction technique. Lavin (1965) has suggested that the inconsistency of findings on differential prediction may be highly related to differences among studies in the content of predictive batteries and in the choice of the different groups of students for which prediction equations were developed.

I believe that a major reason for the limited success of differential prediction studies has been the almost universal reliance on widely used and broadly conceived predictor variables. These variables, such as HSPR, ACT scores, SAT scores, and standardized achievement test scores, have achieved such wide usage largely because they are general in nature and tend to

predict performance in diverse settings and subjects rather well. For this reason, they may not be very well suited to use in differential prediction. The present study compares the usefulness of several widely used variables with the usefulness of variables developed specifically for a particular instructional setting: an introductory college physics course.

Method

This research examined performance in an introductory physics course at a large, highly selective, midwestern university. The course, which was the first in a three-course sequence designed for students majoring in physical science or engineering disciplines, dealt primarily with classical mechanics. The major aim of the course was to prepare students to solve numerical problems involving application of the principles and laws of physics.

Final grades were based on results of three one-hour examinations (100 marks each), a three hour final examination (300 marks), ten problem-solving quizzes (250 marks), and several laboratory reports (150 marks). Quiz and laboratory marks were scaled to compensate for differences of examining standard between quiz-lab instructors.

Ten variables were selected as possible predictors of the total course mark. Six were based on university admissions testing or high school performance: ACT math, ACT natural science, ACT composite, SCAT verbal, SCAT quantitative, and HSPR. Two further variables recorded whether or not the student had taken a high school physics course and how far the student had progressed through the university's sequence of mathematics courses, progress coded from 1 (first algebra course) to 5 (advanced calculus or

beyond). The final two variables were scores on two tests prepared specifically for this research: a 25 minute test of mathematical skills, and a 30 minute test of physics knowledge. The content of the mathematics test was based on a close examination of the mathematics skills needed to understand derivations of equations in the course textbook and to solve the problems assigned as homework in the course. The physics test aimed to assess the student's ability to apply the physics principles covered in the course to simple problems, with the required level of mathematical skill kept to a minimum. The considerable emphasis on mathematical abilities in this set of 10 predictor variables reflects the apparent importance of these abilities to success in physics (Dessel, 1964; Hudson & McIntyre, 1977).

The mathematics and physics tests were administered during the first two class meetings to over 650 students enrolled in the course. Data on the other predictor variables were obtained from student records. Complete sets of data were obtained for 495 of the 579 students who completed the course.

Results

Before examining relationships between predictor variables and the course mark, it is appropriate to examine some characteristics of the predictor variables. The means on all admissions variables were very high (for example, the ACT math mean was 31.3, the ACT composite mean was 27.8, and the HSPR mean was 89.1), and the standard deviations were correspondingly low. This latter feature should be expected to produce lower correlations between predictors and course mark than would be found in a

less selective setting, for reasons discussed earlier. The mathematics test had a KR-21 reliability of .84, and the Physics test a Cronbach's α reliability of .69, both acceptable figures for short tests given the wide range of content covered in these tests.

Insert Table 1 about here

Correlation coefficients among all the predictor variables and the course mark are presented in Table 1. By a considerable margin, the best predictor of the course mark was the mathematics test (r=.60). No other predictor correlated more than .45 with the course mark, although six correlated more than .35. It is interesting to note that 36 percent of the variance in course marks could be accounted for by variation in mathematics test scores, whereas only 16 percent could be accounted for by variation in ACT composite (generally taken to be an indicator of overall scholastic development).

Stepwise multiple regression analyses were used to determine linear combinations of predictor variables which best distinguished between successful and unsuccessful students, as measured by course mark. Three separate analyses were carried out, using different sets of predictor variables. In the first analysis all 10 predictor variables were used, but only four made statistically significant ($p < .01$) contributions to the prediction equation: the mathematics test, the physics test, HSPR, and the index of mathematics courses studied. These four variables accounted for 43.5 percent of the variance in course marks, which is equivalent to a

multiple correlation of .66 between predicted and actual marks. In the second analysis, only the six university admissions variables were used. Four variables (SCAT quantitative, HSPR, ACT mathematics, and ACT natural science) made statistically significant contributions to the prediction equation, accounting for 28.6% of the variance in course marks. This is equivalent to a multiple correlation of .535. The final analysis included only the two variables used in the University selection index: ACT composite and HSPR. Both variables made statistically significant contributions to the prediction equation, accounting together for 23.4% of the variance in course marks, which is equivalent to a multiple correlation of .48.

Discussion

The mathematics test was the best predictor of the course mark, accounting for almost twice as much of the variance as the next best predictor. The six admissions variables (ACT, SCAT, and HSPR) had correlations with the course mark in the range .27 to .45, which is somewhat lower than is commonly found in grade prediction studies (very probably because of restriction of range). Clearly, mathematical skills were particularly important to success in this course.

In the multiple regression analysis which used all 10 predictor variables, three of the four variables which made statistically significant contributions were variables developed specifically for this course: the mathematics test, the physics test, and the index of mathematics courses studied. These three variables, together with HSPR, accounted for 14.9% more variance than the optimum combination of the six admissions variables used in the second regression analysis, even though two measures of

mathematical skills and one of natural science skills were included among the six admissions variables. When only ACT composite and HSPR were used as predictors, the percentage of variance accounted for declined still further. It is also interesting to note that the two general measures of mathematical skills correlated .43 and .45 with the course mark, but the specially constructed test of mathematical skills correlated .60. Likewise, the general measure of science competence correlated .30 with the course mark, but the specially constructed physics test correlated .42.

These results suggest strongly that careful attention to specific skills needed in a given course or curriculum can substantially improve predictions of academic performance. Prediction improved modestly when moderately specific tests (ACT mathematics, ACT natural science, SCAT quantitative and SCAT verbal) were included with the two most general predictors (ACT composite and HSPR). However, a much larger improvement occurred when the four course-specific predictors were added.

The use of context-specific predictors seems likely to be of greatest benefit when predicting performance in individual courses. However, somewhat smaller but very worthwhile improvements should also be achieved when predicting performance in broader curricular areas such as engineering, the physical sciences, and the humanities.

References

Bowers, J., & Loeb, J. Changes in predictor weights in GPA regression equations. Measurement and Evaluation in Guidance, 1972, 5, 438-442.

Commission on Tests. Report of the Commission on Tests: I. Righting the Balance. New York: College Entrance Examination Board, 1970.

Dessel, N. F. Prediction of success in physics for high-ability students--A small sample study. American Journal of Physics, 1964, 32, 197-199.

Fishman, J. A., & Pasanella, A. K. College admission-selection studies. Review of Educational Research, 1960, 30, 298-310.

Hudson, H. T. & McIntyre, W. R. Correlation between mathematical skills and success in physics. American Journal of Physics, 1977, 45, 470-471.

Lavin, D. E. The prediction of academic performance. New York: Russell Sage Foundation, 1965.

Whitla, D. K. Research in college admissions. National Society for the Study of Education Yearbook, 1969, 68 (part II), 81-105.